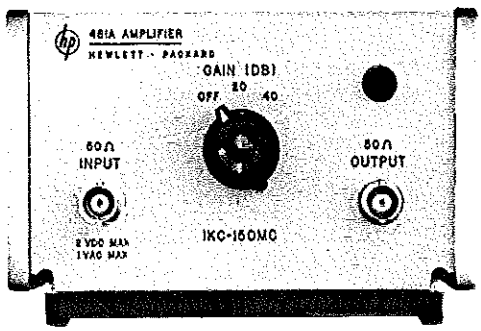
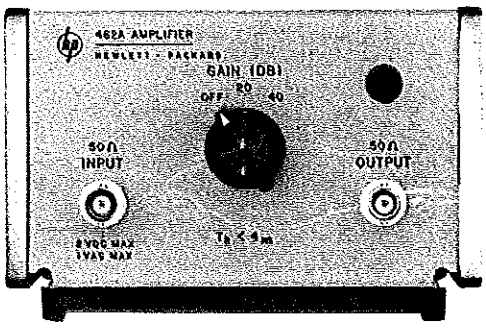
OPERATING AND SERVICE MANUAL

HP 461A/462A

WIDEBAND AMPLIFIER

461A/462A





HEWLETT hp PACKARD

HP 461A/462A

MANUAL CHANGES

MODEL 461A/462A

WIDEBAND AMPLIFIERS

Manual Part No. 00461-90006

New or Revised Item

CHANGE NO. 1: For Serial Numbers:
461A – 0946A05116 and above.
462A – 0947A01681 and above.

Page 6-4. Change 00461-00203 to 00461-00205.

CHANGE NO. 2: For Serial Number 0946A05191 and above (461A).

Page 5-14, Schematic Note 8. Add: R41 to 180 ohm.

Page 5-15/5-16. Change A3R41 and A3R45 to 160.

Page 6-3. After A3L4 and A3L5 descriptions, add "(462A Only)". Also add L4, L5; 00461-86006; Coil:Variable 0.1 μH (461A Only).

Page 6-4. Change A3R41 and A3R45 to 0683-1615, 160 ohms, (461A Only).

CHANGE NO. 3: For All Serial Numbers.

Page 5-3. Change Paragraph 5-10 as follows:

5-10. DISTORTION CHECK (461A).

a. Connect the 461A as shown in Figure 5-2.

b. Set the 461A GAIN (DB) switch to 40.

c. Set the 654A frequency to 500 kHz and minimum OUTPUT AMPLITUDE.

d. Set the 331A to measure RMS VOLTS using the 1 VOLT METER RANGE. Adjust the 654A OUTPUT for a 0.5 volt indication on the 331A Meter.

e. Measure the signal distortion in percentage. The distortion must be less than 5%.

Revise Figure 5-2 as follows:

CHANGE NO. 4 applies to Serial Numbers 0946A05341 and greater for the Model 461A, and Serial Numbers 0947A01721 and greater for the Model 462A.

Page 6-4. Change the Part Number of the "Insulator for Q1" from 1200-0043 to 0340-0580.

CHANGE NO. 5 applies to Serial Numbers 0946A05501 and greater for the Model 461A, and Serial Numbers 0947A01751 and greater for the Model 462A.

Page 5-15/5-16, Power Supply (A2) Assembly Schematic. Change the value of R4 from 5600 to 5100.

Page 6-3, Reference Designator A2 R4. Change Part Number and Description from 0686-5625, R: fxd comp 5.6 kilohm ± 5% ½W to 0686-5125, R: fxd 5.1 kilohm ± 5% ½W.
Delete the relative MFR and MFR. Part Number references.

CHANGE NO. 6 applies to Serial Numbers 0946A05761 and above for the Model 461A.

Page 5-15/5-16. On the schematic diagram change the following capacitor values:

Ref. Desig.	From	To
C9, C10	2.2 μF	6.8 μF
C21, C27, C32	.22 μF	2.2 μF

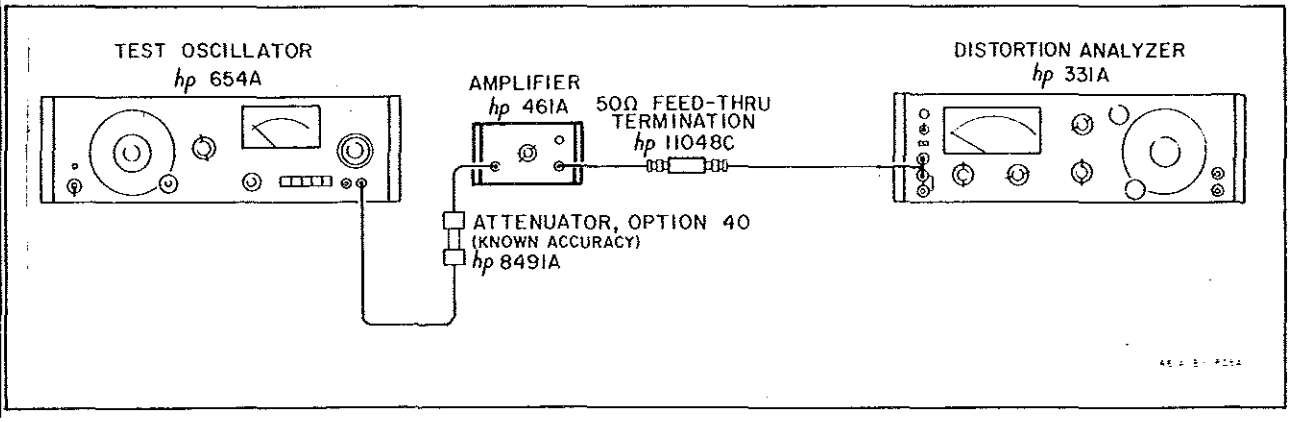


Figure 5-2.

Page 6-3, Table 6-1. Change the following part numbers:

Ref. Desig.	From	To
C9, C10	0180-0155	0180-1701
C21, C27, C32	0160-0170	0160-0128

CHANGE NO.7 For All Serial Numbers.

Page 1-1, Table 1-1. Change the Frequency Response Specification to: Frequency Response: ± 1 dB, 1 kHz to 150 MHz when operating into a 50 Ω resistive load.

Page 5-2. Change Paragraph 5-8 as follows:

5-8. 50 kHz Gain Check (461A and 462A); Output Voltage Check (461A).

b. Set the oscillator to 50 kHz and oscillator amplitude to read 0 dB on the - 10 dB range of the ac voltmeter.

Page 5-3. Change Paragraph 5-9(b) and (e) as follows:

b. Set the oscillator frequency to 50 kHz and adjust its amplitude to read 0 dB on the - 10 dB range of the ac voltmeter.

e. Record the error at 2 MHz for use in Paragraph 5-12. The reference for high frequency response must be 50 kHz.

Page 5-4. Change Paragraph 5-12(c) and (f) as follows:

c. Increase the amplitude of the signal generator to read 0 dB on the 0 dB range of the RF Voltmeter. (Include the variation from the 50 kHz reference as recorded in Paragraph 5-9, Step e.)

f. Connect as in position B. The ac voltmeter must read the reference at 50 kHz (0 dB on the 0 dB range) ± 1 dB or less.

ERRATA

Page 5-8, Paragraph 5-22. Steps d, e and f are printed twice. Delete the second set on top right column.

Page 5-8, Paragraph 5-23(b). Change Step b to read: Connect the ac voltmeter to position "A" and adjust the output of the oscillator for a reading on the ac voltmeter of - 10 dB at 50 kHz.

CHANGE NO. 8 applies to serial numbers 0946A05836 and greater for the Model 461A, and serial numbers 0947A01786 and greater for the Model 462A.

Page 6-4, Table 6-1. Change the part number for XF1 from 1400-0084 to 2110-0170—Post and 2110-0465—Cap. Add the following parts as associated hardware:

2110-0467	Hex Nut	Qty 1
1400-0090	Washer	Qty 1
2190-0054	Washer	Qty 1

CHANGE NO. 9 applies to Serial Numbers 0946A06021 and greater for the Model 461A, and Serial Numbers 0947A01786 and greater for the Model 462A.

Page 6-4. Change the part numbers of L15, 16 to 9140-0179 (Coil: 22UH) Qty 2. Add to Misc. Parts -hp- Part Number 0360-1668 (Term Strip for L15, L16) Qty 1.

CHANGE NO. 10 Applies to all Serial Numbers.

Page 6-4. Change the part number of the "Insulator For Q1" from 0340-0580 to 0340-0583, Reference Change No.4.

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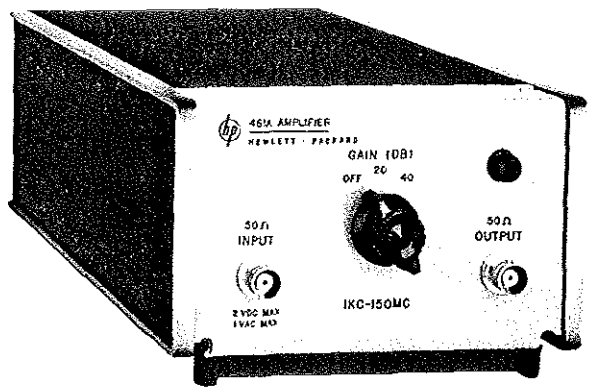


Model 461A
Wide Band Amplifier

Model 462A
Wide Band Amplifier

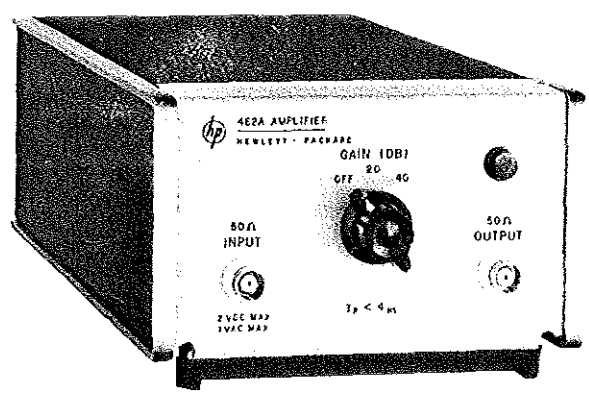


Figure 1-1. Hewlett-Packard Model 461A/462A
Wideband Amplifier

SECTION I
GENERAL INFORMATION

1-1. GENERAL INFORMATION.

1-2. The -hp- Model 461A Wide Band Amplifier is used primarily where flatness is important. The -hp- Model 462A Wide Band Amplifier is used primarily where rise time is important. The Model 461A frequency response is ±1 dB from 1 kHz to 150 MHz. The Model 462A rise and fall times are less than 4 nanoseconds. Either 40 dB or 20 dB gain can be selected with the front panel GAIN (DB switch). The Models 461A and 462A are shown in Figure 1-1. The specifications for both instruments are given in Table 1-1.

1-3. Since the Models 461A and 462A are nearly identical, this manual will discuss the instruments in terms of the Model 461A. The Model 462A will be mentioned only when its operation differs from that of the Model 461A.

1-4. ACCESSORIES AVAILABLE.

1-5. The -hp- 11048C 50-ohm feedthrough termination is an available accessory that is connected at the output of the Model 461A. The feedthrough termination should be used to ensure that the Model 461A is operating into its rated impedance in the event the instrument is connected to a device with an impedance greater than 50 ohms.

Table 1-1. Specifications.

MODEL 461A	MODEL 462A
Frequency Range: 1 kHz to 150 MHz.	Pulse Response: Leading Edge and Trailing Edge Rise Time: Less than 4 nanoseconds Overshoot: Less than 5%
Frequency Response: +/-1 dB, 1 kHz to 150 MHz when operating into a 50 ohm resistive load (500 kHz reference).	Pulse Overload Recovery: Less than 1 us for 10 times overload.
Gain at 500 kHz: 40 dB +/-0.5 dB; or 20 dB +/-1.0 dB, selected by front panel switch (inverting).	Pulse Duration for 10% Droop: 30 us.
Input Impedance: Nominal 50 ohms.	Equivalent Input Noise Level: Less than 40 uV in 40 dB position when loaded with 50 ohms.
Maximum Input: 1 volt rms or 2 volts p-p pulse.*	Input Impedance: Nominal 50 ohms.
Maximum dc Input: +/-2 Volts.*	Maximum Input: 1 volt rms or 2 volts p-p pulse.*
Maximum Output: 1/2 volt rms into 50 ohm resistive load.	Maximum dc Input: +/-2 Volts.*
Equivalent Wideband Input Noise Level: Less than 40 uV in 40 dB position when loaded with 50 Ω	Gain: 20 or 40 dB selected by front panel switch (inverting).
Distortion: Less than 5% at maximum output into rated load.	Maximum Output: 1 volt peak-to-peak into 50 ohm resistive load.
Overload Recovery: Less than 1 microsecond for 10 times overload	Delay: 12-14 nanoseconds

*For the protection of the input circuitry

Table 1-1. Specifications (Cont'd)

GENERAL	
Power Supply: 115 or 230 V +/-10%, 48 to 440Hz, 5 watts.	Weight: Net: 4 lbs (1,8 kg). Shipping: 5 lbs (2,3 kg.).
Dimensions: 5 1/8 in. (13 cm) wide, 3 in. (7,6 cm) high, 11 in. (27,9 cm) deep.	Accessory Furnished: Detachable power cord.
Accessory Available: -hp- 11048C, 50 ohm feedthrough termination.	

1-6. INSTRUMENT IDENTIFICATION.

1-7. Hewlett-Packard uses a two-section serial number. The first section (prefix) identifies a series of instruments. The last section (suffix) identifies a particular instrument within the series. If a letter is included with the serial number, it identifies the country in which the instrument was manufactured. If the serial prefix of your instrument differs from the one on the title page of this manual, a change sheet will be supplied to make this manual compatable with newer instruments or the backdating information in Appendix C will adapt this manual to earlier instruments. All corresponcence with Hewlett-Packard should include the complete serial number.

SECTION II
INSTALLATION

2-1. INTRODUCTION.

2-2. This section contains information and instructions necessary for the installation and shipping of the Model 461A Amplifier. Included are initial inspection procedures, power and grounding requirements, installation information, and instructions for repackaging for shipment.

2-3. INITIAL INSPECTION.

2-4. This instrument was carefully inspected both mechanically and electrically before shipment. It should be free of mars and scratches and in perfect electrical order upon receipt. To confirm this, the instrument should be inspected for physical damage in transit. Also check for supplied accessories, and test the electrical performance of the instrument using the procedure outlined in Paragraph 5-5. If there is damage or deficiency, see the warranty on the inside front cover of this manual.

2-5. POWER REQUIREMENTS.

2-6. The Model 461A can be operated from any source of 115 or 230 volts (+/-10%), at 48 to 440 Hertz. With the instrument disconnected from the ac power source, move the 115/230 V slide switch on the rear panel until the desired line voltage appears. Power dissipation is 5 watts maximum.

2-7. GROUNDING REQUIREMENTS.

2-8. To protect operating personnel, the National Electrical Manufacturers' Association (NEMA) recommends that the instrument panel and cabinet be grounded. All Hewlett-Packard instruments are equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument. The offset pin on the power cable three-prong connector is the ground wire.

2-9. To preserve the protection feature when operating the instrument from a two-contact outlet, use a three-prong to two-prong adapter and connect the green pigtail on the adapter to ground.

2-10. INSTALLATION.

2-11. The Model 461A is fully transistorized; therefore, no special cooling is required. However, the instrument should not be operated where the ambient temperature exceeds 55° C (131° F) or the relative humidity exceeds 95%.

2-12. BENCH MOUNTING.

2-13. The Model 461A is shipped with plastic feet and tilt stand in place, ready for use as a bench instrument.

2-14. RACK MOUNTING.

2-15. The Model 461A may be rack mounted by using an adapter frame (-hp- Part No. 5060-0797). The adapter frame is a rack frame that accepts any combination of submodular units. It can be rack mounted only. For additional information, address inquiries to your -hp- Sales and Service Office. (See Appendix B for office locations.)

2-16. REPACKAGING FOR SHIPMENT.

2-17. The following paragraphs contain a general guide for repackaging of the isntrument for shipment. Refer to Paragraph 2-18 if the original container is to be used; 2-19 if it is not. If you have any questions, contact your local -hp- Sales and Service Office. (See Appendix B for office locations.)

NOTE

If the instrument is to be shipped to Hewlett-Packard for service or repair, attach a tag to the instrument identifying the owner and indicating the service or repair to be accomplished; include the model number and full serial number of the instrument. In any correspondence, identify the instrument by model number, serial number, and serial number prefix.

2-18. If original container is to be used, proceed as follows:

a. Place instrument in original container if available. If it is not available, a suitable container can be purchased from your nearest -hp- Sales and Service Office.

b. Ensure that container is well sealed with strong tape or metal bands.

2-19. If original container is not to be used, proceed as follows:

a. Wrap instrument in heavy paper or plastic before placing in an inner container.

b. Place packing material around all sides of instrument and protect panel face with cardboard strips.

c. Place instrument and inner container in a heavy carton or wooden box and seal with strong tape or metal bands.

d. Mark shipping container with "DELICATE INSTRUMENT," "FRAGILE" etc.

SECTION III
OPERATING INSTRUCTIONS

3-1. INTRODUCTION.

3-2. The Model 461A can be used to faithfully amplify signals in the 1KHz to 150 MHz range. Gain settings of 20 dB or 40 dB may be selected with the front panel GAIN (DB) switch. The Model 461A will operate within specifications only when its output is terminated in 50 ohms.

3-3. FRONT AND REAR PANEL DESCRIPTION.

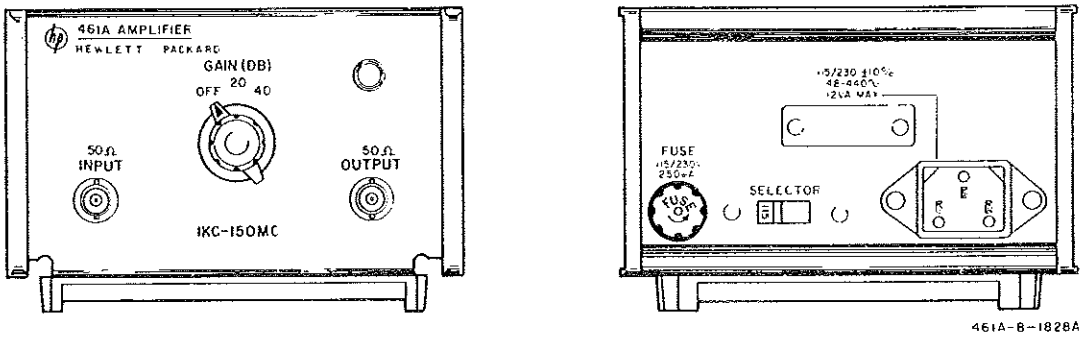
3-4. Figure 3-1 describes the function of all the controls and indicators on both the front and rear panel.

3-5. OPERATING INSTRUCTIONS.

3-6. Figure 3-2 contains the operating instructions for the Model 461A. Each instruction is keyed to a drawing of the front panel.

3-7. IMPEDANCE MATCHING.

3-8. Both the input impedance and the output impedance of the Model 461A are 50 ohms. The Model 461A output must be connected to a 50 ohm load if it is to operate within specifications. If the input impedance of the load is not 50 ohms, a terminating impedance of 50 ohms must be



(1) GAIN (DB) switch: Applies primary power and selects gain.

(2) 50 OHM INPUT connector: Connects input signal to the instrument. DO NOT APPLY MORE THAN 1 VAC OR 2 VDC TO INPUT.

(3) 50 OHM OUTPUT connector: Connects amplified output to load. Output must be terminated in 50 ohm. VOLTAGE LEVEL AT OUTPUT MUST NOT EXCEED -6 VOLTS DC OR +0.6 VOLTS DC.

(4) AC POWER connector: Connects primary power to the instrument.

(5) LINE VOLTAGE: Selects either 115 volts ac or 230 volts ac primary power.

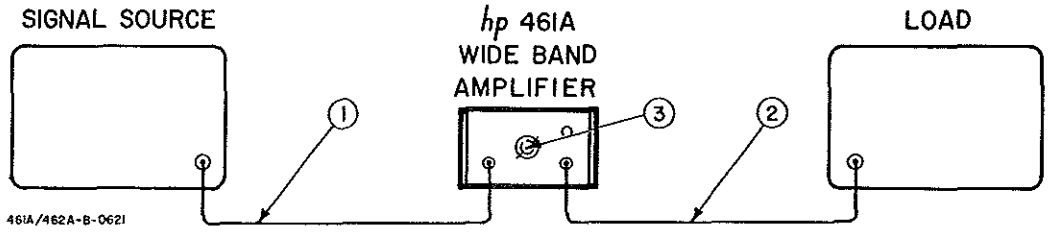
(6) Fuseholder: Contains a 1/4 ampere fast-blow fuse for both 115 and 230 volt operation.

Figure 3-1. Front and Rear Panel Description

connected across the Model 461A output. The -hp- Model 11048C 50 ohm Feedthrough Termination is recommended for this purpose. The Model 11048C may be easily connected in series with the Model 461A output.

3-9. CASCADING AMPLIFIERS.

3-10. The Model 461A will amplify small signals in the 5 to 50 millivolt range to an amplitude of 0.5 volts with minimum distortion. Three 651A's or 652A's can be cascaded with a minimum input of 40 microvolts. For protection of the first instrument, a diode voltage limiter with two diodes in parallel (see Figure 3-3) can be used. To protect the diodes at high voltages a 500 ohm resistor must be placed in series with the input signal. In doing this a ten to one attenuation is obtained for the first amplifier. Therefore the first amplifier must be set to 40 dB gain while the other two should be set to 20 dB gain. The second two amplifier inputs are protected by the clipped output of the preceding amplifier. Should larger output signals be desired, the Model 461A's can be cascaded with other amplifiers. Concerning frequencies from 10 MHz to 150 MHz, the -hp- 230A Power Amplifier can be used in the fourth cascade position.



CAUTION

DO NOT APPLY MORE THAN 1 VAC OR 2 VDC TO INPUT TERMINALS. VOLTAGE LEVEL APPLIED TO OUTPUT MUST NOT EXCEED -6 VOLTS DC OR +0.6 VOLTS DC.

(1) Connect the 1 KHz to 150 MHz frequency source to the input of the Model 461A.

(2) Connect the output of the Model 461A to a 50-ohm load.

(3) Set Power and Gain Switch to the desired gain setting (20 or 40 dB).

NOTE

The maximum output voltage obtainable from the Model 461A is 0.5 volts rms (1 Volt P-P for Model 462A). Thus the maximum input voltage that can be applied, without distortion, is 50 mv on the 20 dB range, and 5 mv on the 40 dB range.

Figure 3-2. Operating Instructions

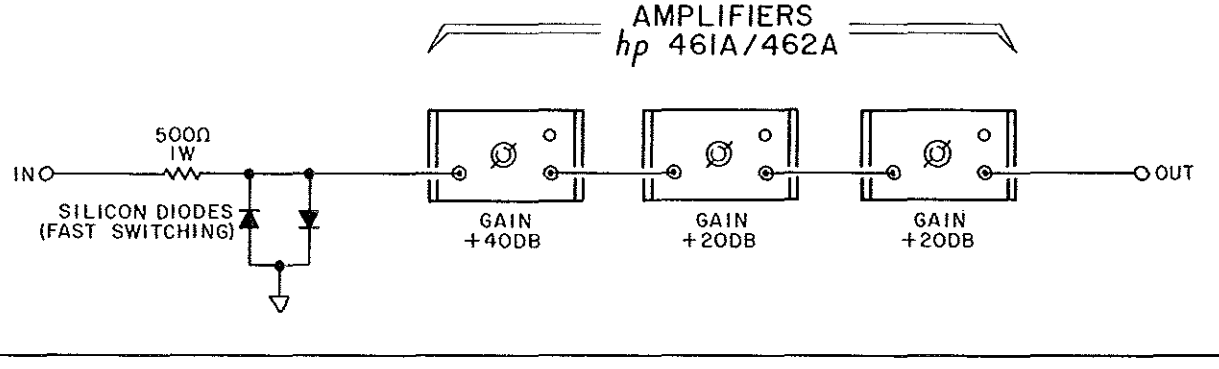


Figure 3-3. Cascading 461A or 462A Amplifiers with Input Protective Circuit

SECTION IV
THEORY OF OPERATION

4-1. GENERAL DESCRIPTION.

4-2. The Models 461A and 462A Amplifiers are essentially identical. In the Model 462A some of the component values are changed slightly to improve its pulse response. In this section both instruments will be presented in terms of the Model 461A.

4-3. Figure 4-1 shows a simplified block diagram of the Model 461A. The amplifier is a five stage, stagger-tuned, cascaded amplifier with emitter follower input and output stages. The gain is switched from 40 dB to 20 dB by attenuating the input by 20 dB. The power supply is a conventional series regulated supply with +15 volt and -15 volt outputs.

4-4. AMPLIFIER CIRCUITS.

4-5. Figure 5-12 shows the schematic diagram of the Model 461A. A3Q3 is the input emitter follower, matching the 50 ohm input impedance to the input impedance of the amplifier. Transistors A3Q4 through A3Q8 constitute a five stage, RC coupled, cascaded amplifier. Each stage has a gain of 8.4 dB. 2 dB is lost in the input and output emitter followers, giving the amplifier a total gain of 40 dB.

4-6. Each stage has an an LR feedback circuit with an adjustable inductor. The feedback circuit in each stage controls the overall gain of the amplifier at a different frequency, so the amplifier must be stagger-tuned. There is some interaction between the stages at certain frequencies. A3Q9 is the output emitter follower, and it matches the amplifier output to a 50 ohm output impedance.

4-7. POWER SUPPLY.

4-8. The power supply generates +15 volts and -15 volts bias supply to the amplifiers. Breakdown diode A2CR3 establishes a 15 volt reference. Control transistor A2Q2 detects differences between the reference voltage and the supply output, and its output controls the series regulator Q1.

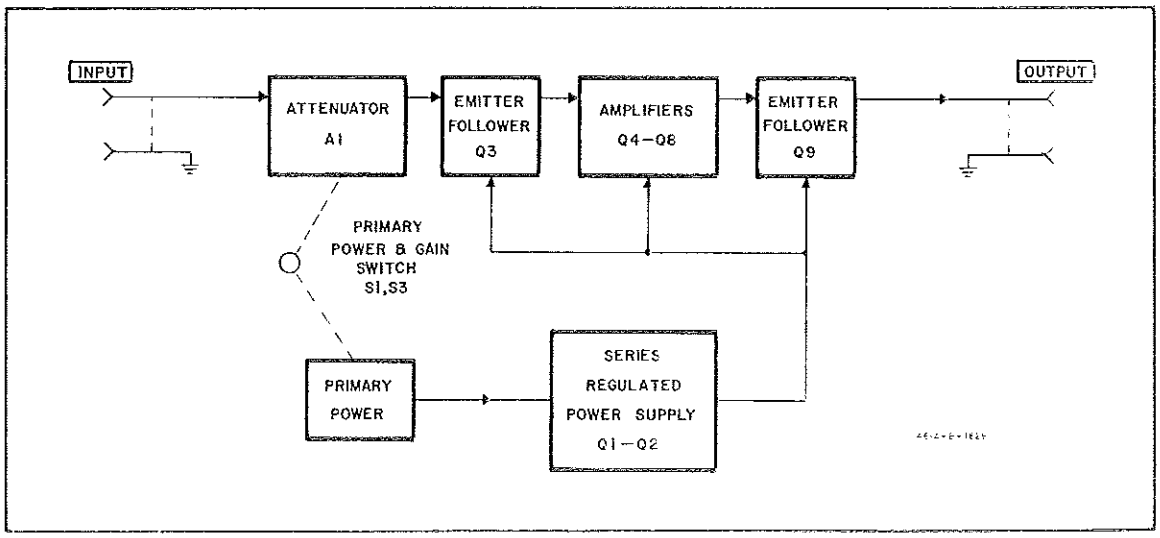
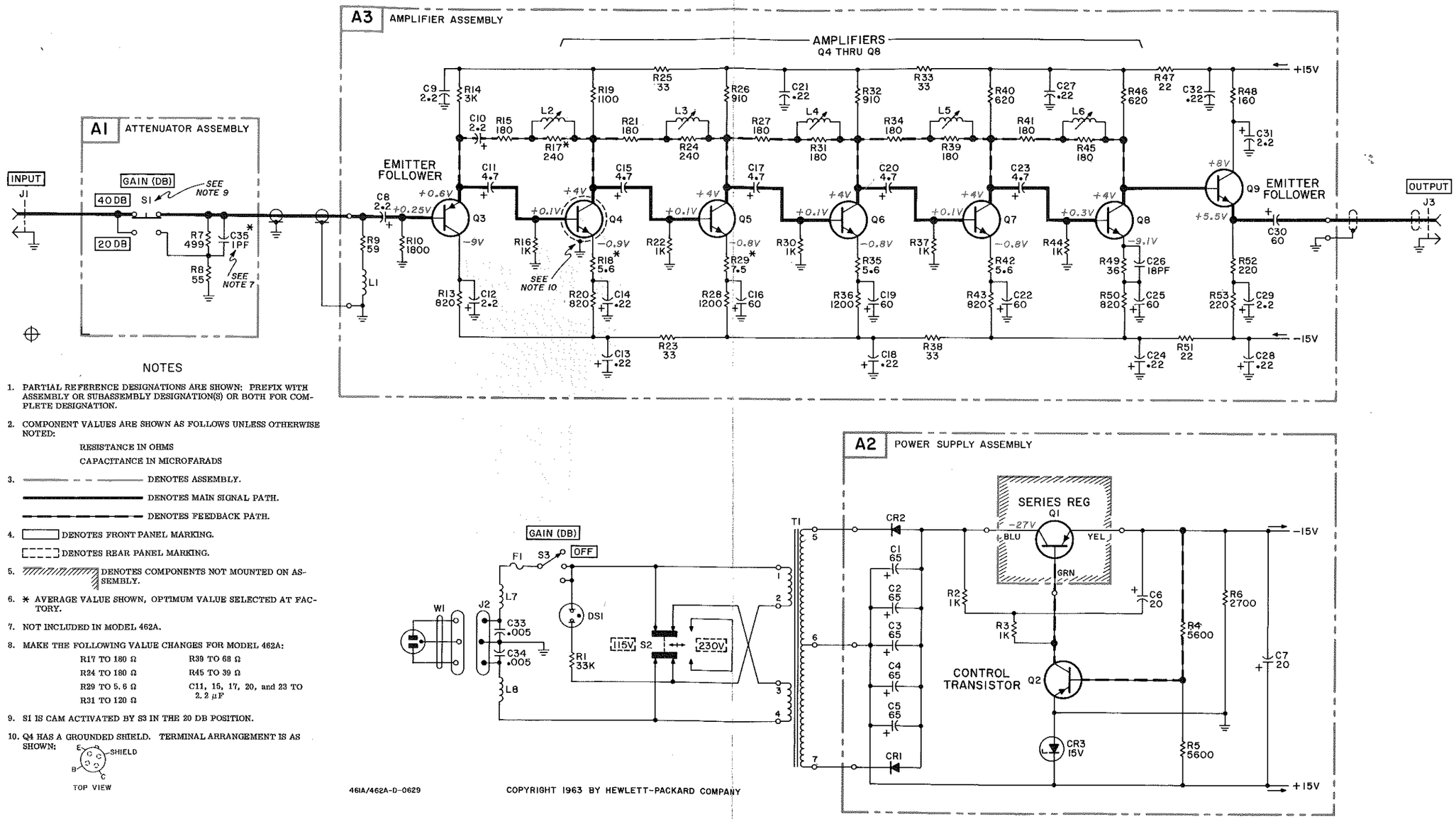


Figure 4-1. Simplified Block Diagram

Table 5-1. Test Equipment Required

INSTRUMENT TYPE	CRITICAL SPECIFICATIONS	USE	RECOMMENDED MODEL
Wide Range Oscillator	Output: 0.5 volts Impedance: 50 ohms Freq. Range: 1 kHz to 10 MHz Level: 0.5% Distortion: less than 0.5%	Low Freq. Response and Gain Check	-hp- Model 654A Test Oscillator
Logarithmic Voltmeter	Accuracy: +/-1% reading to +/-5% reading Freq. Range: 1kHz to 10 MHz DB range: -80 dB to +50 dB	Calibration, Low Freq. Response and Gain Check	-hp- Model 400EL AC Voltmeter
Attenuator	Attenuation: 20 dB Accuracy: 0.1 dB (1 kHz to 150 MHz)	Gain Check Freq. Response Check and Calibration	-hp- Model 8491A Option 20 with known accuracy
Attenuator	Attenuation: 40 dB Accuracy: 0.1 dB (1 kHz to 150 MHz	Gain Check Freq. Response Check and Calibration	-hp- Model 8491A Opiton 40 with known accuracy
Distortion Analyzer	Freq. Range: 1 kHz to 500 kHz Sensitivity: Measure 5% Distortion Accuracy: +/-3%	Distortion Check	-hp- Model 331A, 333A or 334A Distortion Analyzer
RF Millivolt-meter	Freq. Range: 500 kHz to 150 MHz Accuracy: from +/-3% to +/-5% f.s. DB Range: -50 to +20 dBm	Frequency Response Check and Calibration	-hp- Model 3406A RF Sampling Voltmeter
Multimeter including DC Voltmeter	Accuracy: +/-1% of full scale Input Resistance greater than 10 Megohm	Power Supply Checks and Troubleshooting	-hp- Model 412A Volt-Ohm-Ammeter
Signal Generator Sweeper	Freq. Range: 100 kHz to 110 MHz Output: 0.5 V Flatness: 0.20 dB over full range Impedance: 50 ohms	High Freq. Response Check and Adjustment	-hp- Model 8601A Generator/Sweeper
Oscilloscope	Bandwidth: dc to 50 MHz with horizontal magnifier Sensitivity: 0.005V/cm to 20V/cm	Pulse Droop Calibration and Overload Check	-hp- Model 180C Oscilloscope with 1801A and 1820A plug-ins



NOTES

1. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN: PREFIX WITH ASSEMBLY OR SUBASSEMBLY DESIGNATION(S) OR BOTH FOR COMPLETE DESIGNATION.
2. COMPONENT VALUES ARE SHOWN AS FOLLOWS UNLESS OTHERWISE NOTED:
   RESISTANCE IN OHMS
   CAPACITANCE IN MICROFARADS
3. ——— — — ——— DENOTES ASSEMBLY.
   ——————— DENOTES MAIN SIGNAL PATH.
   — — — — — DENOTES FEEDBACK PATH.
4. ▭ DENOTES FRONT PANEL MARKING.
   ▭ DENOTES REAR PANEL MARKING.
5. ▨ DENOTES COMPONENTS NOT MOUNTED ON ASSEMBLY.
6. * AVERAGE VALUE SHOWN, OPTIMUM VALUE SELECTED AT FACTORY.
7. NOT INCLUDED IN MODEL 462A.
8. MAKE THE FOLLOWING VALUE CHANGES FOR MODEL 462A:

R17 TO 180 Ω	R39 TO 68 Ω
R24 TO 180 Ω	R45 TO 39 Ω
R29 TO 5.6 Ω	C11, 15, 17, 20, and 23 TO 2.2 μF
R31 TO 120 Ω	

9. S1 IS CAM ACTIVATED BY S3 IN THE 20 DB POSITION.
10. Q4 HAS A GROUNDED SHIELD. TERMINAL ARRANGEMENT IS AS SHOWN:

TOP VIEW

461A/462A-D-0629

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Figure 5-13. Schematic Diagram of Model 461A/462A